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Bactrodesmiastrum domesticum sp. nov. and *Conioscypha varia* from indoor environments

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Abstract—Two hyphomycetes were collected from residences: a new species, *Bactrodesmiastrum domesticum*, with turbinate or obtriangular conidia and *Conioscypha varia*, reported for the first time from an indoor environment.

Key words—building, dry wall, asexual fungi, water damage, wood

Introduction

Indoor environments provide man-made and unique habitats for fungi. Building materials, such as drywall and wood, and household materials such as clothing, fabric, books, paper products, foodstuffs, etc. are good substrates for fungi whenever water or moisture is available. There have been historical studies on indoor fungi (e.g., the notorious *Stachybotrys chartarum* (Ehrenb.) S. Hughes [= *Stachybotrys atrus* Corda] collected from an indoor wall in Prague during the early 19th century; Corda 1837), but fungal diversity in indoor environments has not been well studied, perhaps due to the misconception that fungal diversity in indoor environments is simple and straightforward. However, an increasing number of fungi have been added to the list of indoor fungi in the last two decades, some new to science and others as first records for the countries where they were collected. We report here on two unique hyphomycetes were collected from indoor environments in the USA, one a new species and the other representing a first occurrence for an indoor environment.

Materials & methods

Two fungi were collected during indoor mold inspections in Florida and Massachusetts. These fungi were grown on malt extract agar (MEA), corn meal agar (CMA) and dichloran glycerol agar (DG18) at 25°C. A small scalpel was used to remove fungal structures directly from the samples or from culture for morphological observation under a compound microscope. Conidiophores, conidiogenous cells, and conidia were mounted in 85% lactic acid or lacto-fuchsin (0.1 g acid fuchsin, 100 ml 85% lactic acid; Carmichael 1955) and microscopically observed and measured using an Olympus BX40 compound microscope equipped with Nomarski differential interference contrast optics and photographed using an Olympus Microfire digital camera (Goleta, CA). The fungal structure measurements were statistically analyzed using Microsoft Office Excel 2013 with 95% confidence interval of means. The results are presented as ranges of the measurement. Specimens were conserved in the Herbarium, Connecticut Agricultural Experiment Station, New Haven, CT, USA (NHES).

Taxonomy

Bactrodesmiastrum domesticum D.W. Li & Chin S. Yang, **sp. nov.** PLATE 1

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Differs from *Bactrodesmiastrum monilioides*, *B. obovatum*, and *B. obscurum* by its much larger turbinate conidia and from *B. pyriforme* by its much wider turbinate conidia.

TYPE: USA, Florida, Miami Shores, unidentified decayed wood (floor plank) in a residence, 18 March 2013, Albert Baerren, Prestige 130320-01-001 (**Holotype**, NHES L1701).

ETYMOLOGY: epithet is named after the indoor habitat where this fungus was collected.

COLONIES on the natural substrate effuse, sparse, light brown. Mycelia partly superficial and partly immersed in the decayed wood. Hyphae branched, septate, pale brown to brown, smooth, thick-walled, 2.5–3 µm diam. CONIDIOPHORES poorly differentiated or undifferentiated, often reduced to conidiogenous cells, very rarely developing a septum and separated into two cells, straight, rarely flexuous, unbranched, solitary. CONIDIOGENOUS CELLS monoblastic, smooth, thick-walled, pale brown to brown, much darker than the adjacent hyphal cells to both sides, (4.5–)3.7–7(–8) µm (n = 6) long, (2.5–)3.5–5.5 µm (n = 6) diam at the base, determinate, attenuated towards the apex, conical, tubular, barrel-shaped or (rarely) ovoid, truncate at the apex, occasionally L shaped or short inverse T shaped, 2–4.5(–5) µm (n = 11) diam. CONIDIAL SECESSION schizolytic CONIDIA (2–)3(–4) septate, acrogenous, turbinate or obtriangular

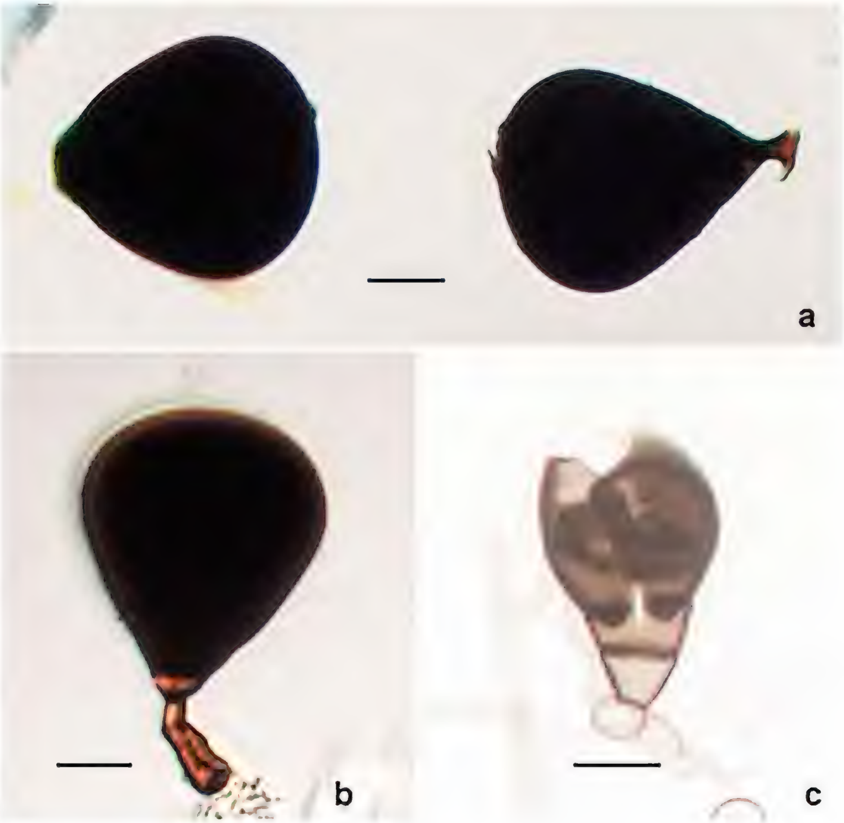

Plate 1. *Bactrodesmiastrum domesticum* (holotype, NHES L1701). a. Conidia and conidiogenous cell; b, c. Conidia and conidiogenous cells. Scale bars = 10 µm.

with a rounded distal side, black, smooth, glistening, solitary, dry, (36.5–) 39.5–43.5(–47) × (30–)33–37(–37.5) µm (n = 30), with distal cells darker than the proximal cell, conico-truncate at the base. Sexual state unknown.

Notes: *Bactrodesmiastrum* Hol.-Jech. is characterized by solitary or poorly aggregated differentiated or undifferentiated conidiophores reduced to a conidiogenous cell that is monoblastic, brown, single (Holubová-Jechová 1984) and contrasts with *Bactrodesmium*, which develops sporodochia and differentiated, colorless to brown, simple or branched conidiophores that develop mono- or polyblastic conidiogenous cells (Ellis 1971, Holubová-Jechová

1972). *Bactrodesmiastrum* was typified by *B. obscurum* Hol.-Jech. (Holubová-Jechová 1984), which has flask-shaped conidiogenous cells with a truncate apex and obovoid versicolored conidia with a conico-truncate basal cell. Hernández-Restrepo et al. (2013) added two new species, *Bactrodesmiastrum pyriforme* M. Hern.-Rest. et al. and *B. obovatum* (M. Calduch et al.) J. Mena et al. [≡ *Janetia obovata* M. Calduch et al.].

When describing another new species, *B. monilioides* Hern.-Rest. et al., Hernández-Restrepo et al. (2015) emended the genus by expanding the conidiophore description from "reduced to a conidiogenous cell which is monoblastic, brown, single" to "semi-macronematous or macronematous, mononematous, simple, usually reduced to conidiogenous cells arranged singly or aggregated in small groups, or conidiophores arising from pulvinate to subpustulate, scattered and black sporodochial conidiomata". All four previously published species were collected or isolated from decaying or submerged wood or twigs and exclusively in Europe; *B. domesticum* represents the first *Bactrodesmiastrum* species reported from a different habitat as well as from another part of the world.

Bactrodesmiastrum domesticum can easily be distinguished from *B. monilioides*, *B. obovatum*, and *B. obscurum*, which have much smaller non-turbinate conidia: *B. monilioides* 24–35 × 15–18 µm, *B. obovatum* 22.5–33.5 × 12–15 µm, and *B. obscurum* 24–35 × 11–15 µm. (Hernández-Restrepo et al. 2013, 2015; Holubová-Jechová 1984). *Bactrodesmiastrum domesticum* and *B. pyriforme* develop conidia of similar lengths, but those of *B. pyriforme* are pyriform and narrower (14–28 µm; Hernández-Restrepo et al. 2013).

Bactrodesmiastrum domesticum also resembles *Trichocladium achrasporum* (Meyers & R.T. Moore) Shearer & J.L. Crane, *T. nypae* K.D. Hyde & Goh, and *T. palmae* Manohar. et al. in morphology of conidia and conidiogenous cells. However, *T. achrasporum* develops sporodochia and produces much smaller (17–24 µm × 10–16) conidia (some with dark bands at the septa) that are pyriform, not turbinate (Shearer & Crane 1971); *T. nypae* develops much smaller (15–20 × 10–13 µm) and pyriform to ellipsoidal conidia (Hyde et al. 1999); and *T. palmae* has finely verrucose conidia (28–36.5 × 18.5–24 µm; Manoharachary et al. 2006).

Both *Bactrodesmium linderi* (J.L. Crane & Shearer) M.E. Palm & E.L. Stewart and *Ba. moenitum* (J.L. Crane & Shearer) M.E. Palm & E.L. Stewart resemble *B. domesticum* somewhat in conidial morphology. However, these species clearly differ from *B. domesticum: Ba. linderi* by its production of sporodochia and its much smaller pyriform conidia (15–28 × 11–18 µm) and *Ba. moenitum*

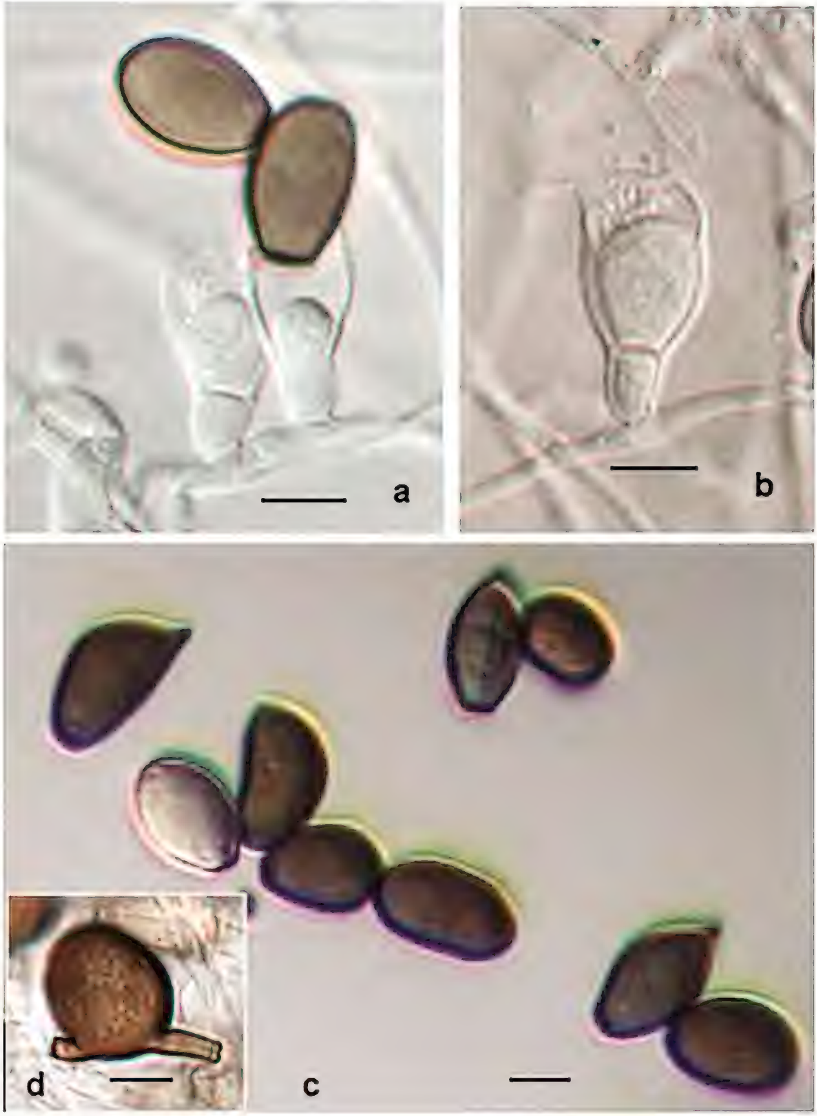

Plate 2. *Conioscypha varia* (NHES L1702). a. Conidia and conidiogenous cells; b. Conidiogenous cell; c. Conidia; d. Conidium developed on hypha. Scale bars = 5 µm.

by its production of sporodochia and its much narrower pyriform conidia (31–48 × 11–27 µm; Palm & Stewart 1982).

Hernández-Restrepo et al. (2013) found that *Ascotaiwania persoonii* Fallah et al., *B. obovatum*, and *B. pyriforme* formed a monophyletic clade with 99% support. (The anamorph of *A. persoonii* is unknown; Fallah et al. 1999). This clade was sister (with 99% support) to a /Savoryellales clade that included three different *Ascotaiwania* species. Similarly, Hernández-Restrepo et al. (2015, in an analysis that did not include *A. persoonii*) found that *B. monilioides*, *B. obovatum*, and *B. pyriforme* formed a monophyletic clade with 99% support that was sister (with 95% support) to a /Savoryellales clade that included four different *Ascotaiwania* species (including the type species, *A. lignicola*). The extensive phylogenetic analysis by Yang et al. (2016) defined a major lineage (with 100% support), which they proposed as a new family and order (*Fuscosporellaceae*, *Fuscosporellales*); this included *B. monilioides*, *B. obovatum*, and *B. pyriforme*, as well as *A. persoonii*, which they recombined as the type of a new genus *Pseudoascotaiwania* Jing Yang et al., remote from *Ascotaiwania* sensu stricto (*Savoryellales*).

Our attempts to culture *B. domesticum* have been unsuccessful. *Trichoderma koningii* Oudem., *Scopulariopsis brevicaulis* (Sacc.) Bainier, and *Fusicladium aromaticum* (Ellis & Everh.) K. Schub. & U. Braun [≡ *Cladosporium aromaticum* Ellis & Everh.] co-existed on the same wood sample.

Conioscypha varia Shearer, Mycologia 65: 133 (1973) PLATE 2

≡ *Conioscyphascus varius* Réblová & Seifert, Stud. Mycol. 50(1): 101 (2004)

COLONIES growing slowly on MEA and CMA, no growth on DG18; reaching 21–24 mm diam on MEA and 22–24 mm diam on CMA after four weeks at 25°C; on MEA black, velvety, partly immerse, raised at center with a serrate 2.5 mm wide white edge band, radially sulcate, reverse dark gray; on CMA mycelium white, inconspicuous, colonies low, plane, buff, pale gray at center on both sides. Hyphae colorless, thin-walled, septate, smooth, some cells moniliform. CONIDIOPHORES undifferentiated, single, short, colorless, smooth, unicellular, reduced to conidiogenous cells. CONIDIOGENOUS CELLS intercalary or terminal, colorless, cyathiform, (2.7–)3.8–5.4(–5.6) × (2.4–)2.8–3.6(–4.1) µm (n = 20), with a colorless multilayered cup-shaped collarette formed by previously ruptured outer conidiogenous cell walls. CONIDIA 1-celled, solitary, smooth, thick-walled, translucent when immature, becoming dark brown when mature, variably shaped, most ellipsoidal, ovoid, or pyriform with a germ pore at the apical and basal ends, a few subspherical or even irregular, (9.5–)10.5–13.5(–14.7) × (6–)6.3–7.3(–7.5) µm (n = 30), some with truncate basal end (2.2–)2.7–3.3(–4) µm (n = 30) or apiculate, developing singly and successively by percurrent extensions of the conidiogenous cell apices, secession schizolytic, occasionally conidia developing directly on hyphae; mature conidia seceding and released by rupture at the apex of the conidiogenous cell outer wall. Each conidium leaves a layer of cup-like collarette in which a new conidium will develop.

Specimen examined: **USA, Massachusetts**, Hingham, wall of a residence, 4 February 2013 (NHES L1702).

Distribution: Czech Republic, Panama, USA.

Substrates/hosts: Dry wall, *Scheelea zonensis* (Corozo palm), decayed wood of *Ulmus glabra* and an unidentified deciduous tree, and submerged *Ochroma pyramidale* (balsa) wood (Piepenbring 2006; Shearer 1973).

Notes: Höhnel (1904) erected *Conioscypha*, typified by *C. lignicola* Höhn. Shearer (1973), who described *Conioscypha varia* based on a specimen collected from submerged balsa wood in the Patuxent River, MD, USA, emended the generic concept of *Conioscypha* with detailed information from her study on the conidiogenesis of *C. lignicola*. Réblová & Seifert (2004) established *Conioscyphascus*, a new ascomycete genus in which both species, *Conioscyphascus varius* (type species) and *Conioscyphascus gracilis* (Munk) Réblová & Seifert, develop *Conioscypha* anamorphs. Their phylogenetic LSU sequence analyses place *C. japonica* Udagawa & Toyaz., *C. lignicola*, and *Conioscyphascus varius* in a monophyletic clade. *Conioscypha* (proposed in 1904 and with 17 species) has priority over *Conioscyphascus* (proposed in 2004 and with only two species) and is the generic name of choice for both the asexual and sexual morphs under the "1Fungus :1Name" principle. The *C. varia* isolate collected indoors in Massachusetts did not develop the teleomorph.

Conioscypha varia is reported here as an indoor fungus for the first time. The isolate collected indoors from drywall grew at a similar rate on CMA and MEA, but produced no growth on DG18, indicating that *C. varia* is a hydrophilic, not xerophilic, fungus. The holotype and four specimens of *C. varia* were all collected during 1967–1969 from submerged balsa wood in Patuxent (Shearer 1973), a habitat indicating that it is an aquatic fungus. Its ecological characters would make *C. varia* useful as an indicator fungus for long-term water damage in indoor environments. After 40 years since this species was collected and proposed as a new species, *C. varia* was once more collected in the USA, but this time from an indoor environment and not from wood submerged in the water.

It is possible that *C. bambusicola* Matsush. is conspecific with *C. varia*. Conidia of these two species are similar in size. Conidia of *C. bambusicola* are ovate and apiculate, while those of the *C. varia* holotype are variably shaped—ovoid flammiform, naviculiform, subellipsoidal—with apiculate or rounded apices and some conidia are ovoid, naviculiform, apiculate (Shearer 1973). The shapes of the mature conidia from the isolate collected from the Massachusetts indoor environment appeared similarly variable as those described by Shearer (1973), while the immature conidia were mostly ovoid and apiculate, resembling those described for *C. bambusicola*. Conidia from the isolate of *C. varia* studied by Réblová & Seifert (2004) were ellipsoidal with a rounded apex. The status, delineation, and relationship of these two species should be further studied.

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Literature cited

Carmichael J. 1955. Lacto-fuchsin: a new medium for mounting fungi. Mycologia 47: 611.

Corda ACJ. 1837. Icones fungorum hucusque cognitorum 1. Prague, J. G. Calve.

Fallah PM, Crane JL, Shearer CA. 1999. Freshwater ascomycetes: two new species of *Ascotaiwania* from North America. Canadian Journal of Botany 77: 87–92. https://doi.org/10.1139/b98-202

Hernández-Restrepo M, Mena-Portales J, Gené J, Cano J, Guarro J. 2013. New *Bactrodesmiastrum* and *Bactrodesmium* from decaying wood in Spain. Mycologia 105: 172–180. https://doi.org/10.3852/12-004

Hernández-Restrepo M, Gené J, Castañeda-Ruiz RF, Mena-Portales J, Guarro J. 2015. Emendation of the genus *Bactrodesmiastrum* (*Sordariomycetes*) and description of *Bactrodesmiastrum monilioides* sp. nov. from plant debris in Spain. Mycological Progress 14: 48 [7 p.]. https://doi.org/10.1007/s11557-015-1067-6

Höhnel F von. 1904. Mycologische fragmente. Annales Mycologici 2: 38–60.

Holubová-Jechová V. 1972. Lignicolous hyphomycetes from Czechoslovakia – 2. *Bactrodesmium*. Folia Geobotanica et Phytotaxonomica 7(4): 407–418. https://doi.org/10.1007/BF02854768

Holubová-Jechová V. 1984. *Bactrodesmiastrum*, a new genus of lignicolous hyphomycetes. Folia Geobotanica et Phytotaxonomica 19: 103–106. https://doi.org/10.1007/BF02853338

Hyde KD, Goh TK, Lu BS, Alias SA. 1999. Eleven new intertidal fungi from *Nypa fruticans*. Mycological Research 103: 1409–1422. https://doi.org/10.1017/S0953756299008667

Manoharachary C, Agarwal DK, Sureshkumar G, Kunwar IK, Babu KS. 2006. *Memnoniella mohanramii* sp. nov. and *Zygosporium anupamvarmae* sp. nov. from India. Indian Phytopathology 59: 489–491.

Palm M, Stewart E. 1982. Two new combinations in *Bactrodesmium*. Mycotaxon 15: 319–325.

Piepenbring M. 2006. Checklist of fungi in Panama: Preliminary version. Puente Biológico 1: 1–190.

Réblová M, Seifert KA. 2004. *Conioscyphascus*, a new ascomycetous genus for holomorphs with *Conioscypha* anamorphs. Studies in Mycology 50: 95–108.

Shearer CA. 1973. Fungi of the Chesapeake Bay and its tributaries II. The genus *Conioscypha*. Mycologia 65: 128–136. https://doi.org/10.2307/3757793

Shearer CA, Crane J. 1971. Fungi of the Chesapeake Bay and its tributaries. I. Patuxent River. Mycologia 63: 237–260. https://doi.org/10.2307/3757758

Yang J, Maharachchikumbura SSN, Bhat DJ, Hyde KD, McKenzie EHC, Jones EBG, Al-Sadi AM, Lumyong S. 2016. *Fuscosporellales*, a new order of aquatic and terrestrial *Hypocreomycetidae* (*Sordariomycetes*). Cryptogamie, Mycologie 37(4): 449–475. https://doi.org/10.7872/crym/v37.iss4.2016.449